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Consultation on the Food-Processing Industry
with Emphasis on Fruit and Vegetable Processing

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# BASIC REQUIREMENTS FOR LONG-TERM VIABILITY OF THE FRUIT AND VEGETABLE PROCESSING INDUSTRY*

Prepared by the
UNIDO Secretariat

* This document has not been edited.

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## I. Introduction

1. Although the current global food situation is much improved in comparison with the mid-1970's, the problem of food supply and security in developing countries continues to be a major concern to governments and international development agencies. Many developing countries continue to face immense problems in ensuring adequate supplies of food on a regular, year-to-year basis and the number of malnourished people has increased.

2. Reduction in the availability of fruits and vegetables which are important sources of minerals and vitamins aggravates the malnutrition* problem and negatively affects people's capacity to work, learn and effectively function in society.

3. Of the total world fruit crops, nearly 60 per cent come from subtropical and an additional 25 per cent from tropical zones. Citrus fruits are the most important species for the developing countries. They had a share of 50 per cent in the 1980 world crop, and this will probably be increased to 56 per cent in the 1990s. Some 95 per cent of tropical fruits are cultivated in developing countries.

4. Only 15-20 per cent of the fruit and vegetables from the developing countries are exported in preserved (processed) state, and juices represent 22-27 per cent of these exports. This amount is higher in Latin America, where the rate exceeds 30 per cent, 90 per cent of which is in the form of concentrated juices. In the last few years, the rate of processed produce has shown an increase owing to the increase of juice exports. The average rate of processing of genuine tropical fruits does not reach 5 per cent.

## II. National Strategies and Policies. Integrated development objectives and instruments

5. Dilemmas always exist for developing countries in setting priorities (urban versus rural, exporting cash crops versus producing subsistence crops) although economists have rejected dichotomies such as agricultural versus industrial development and have continually emphasized the growing interdependence of these two sectors. One of the main characteristics of food processing industry consists in the fact that, through sound national strategies and policies, a balanced development can be achieved so that farmers and entrepreneurs, irrespective of whether they are small or big, have access to modern technology which will increase yield, productivity and

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* The term malnutrition is used to describe food intake that is quantitatively and/or qualitatively inadequate and which results in physical effects on the human body.

income. Public policy instruments such as agricultural taxation, investment in infrastructure including research, price, marketing and trade policies have, as basic condition, to be integrated in a coherent economic framework.

6. Although governments' target areas would be staple foods, the fruit and vegetable sector is bound to receive appreciable attention since in some countries certain fruits and vegetables may be considered as staples (banana, potatoes, cassavas) and since, in many cases, there is overproduction of seasonal fruit and vegetables which, if not processed, would go to waste. Besides, it is well appreciated that the development of the sector supplements the food supply, can give an important boost to rural development, and increase incomes and employment. The sector can be a foreign exchange earner through exports, or a foreign exchange saver through import substitution.

7. There are obviously many activities, which small- and medium-scale entrepreneurs, who constitute the majority in the sector and who include probably all the indigenous processors, cannot afford to finance. The degree and level of government involvement and financing in the above activities, are determinant pre-conditions for the development of the fruit and vegetable sector and for attracting local and foreign investments to the sector. Government promotional measures mainly concentrate on:

- ensuring an adequate supply of raw materials, of the right quality, at the right price and at the right time;

- creating facilities for the quick transfer of produce from farms to processing units to avoid post harvest losses;

- supporting processor to be able to accept all available farm produce and to obtain a fair return on their investments.

8. The most critical point that emerges is that the policies and strategies of the government concerned should be reoriented for building a strong and viable agro-industrial base, and to this end, there should be a commitment to provide necessary incentives and infrastructure which is most essential, for a dynamic private sector to flourish and to attract private foreign investment. The removal of restrictions and liberalization of policies will attract increased foreign investments, and inflow of modern technology, which will contribute to the solution of the problems currently faced by the developing countries in the region.

## III. Rational integration between agriculture and industry

9. The interdependence between agriculture and food industry as well as between the food and non-food industry influence macro policy processes in both developing and developed countries. Agricultural products provide inputs for the processed food sector which, in its turn, generates output for the non-food sector whereas the non-food sector provides inputs for agriculture. The link between agriculture and industry stretches, therefore, to farm and non farm inputs, consumption goods and capital goods. Investigations of such interdependence are, thus, essential to understand important macro and micro-economic processes.

10. The linkages with raw material producers should be strengthened and supported through research work, quality control, contractual arrangements and pricing systems in the recognition that the management of raw material is critical to the viability and efficiency of the industry.

11. The concept of a fruits and vegetables integrated plant, combining into one system all the links of the production chain, offers opportunities for progress in the food supply system, especially in the developing countries. The idea is to join into one logical unit the industries producing inputs and providing services for agriculture; agricultural production itself; procurement, transportation, and storage of agricultural raw materials; and the agro-industries and fruit and vegetables processing industries.

12. The physical proximity of industry to the raw materials production areas is one of the pre-conditions for improving the productivity of food processing plants, in particular fruits and vegetables. As a matter of fact inadequate planning and availability of raw materials have been identified as major causes of low levels of performance.

13. By siting processing plants near to the sources of raw materials, a wider spread of industrial growth is achieved which covers rural regions as well. With its stimulating effects on agriculture, the fruits and vegetables industry would thus contribute to a balanced, meaningful and sustained growth. Basic processing activities taking place in rural areas minimize the cost of transportation of bulky products and maximize freshness.

14. The relationship between the agricultural producer and industry can be regulated and fostered through supply/purchase contracts as well as through a direct investment by the processing industry which, in this way, can better plan and orient quality and quantity of raw material for processing purpose.

15. The industry, contracting the agricultural producers, supplies them with seeds and other farm inputs, gives guidance from the planting to the harvesting period as well as on post-harvesting practices, transportation and storage.

16. Approximately 25% of the global food supply is lost through spoilage, pests and waste. In the fruit and vegetable sector the percentage lost is even higher since fruit and vegetable are seasonal and perishable commodities, consequently their prices fluctuate between the lowest during the glut period and the highest during off-season. Cold storage facility serves for short term preservation and that is insufficient for certain fruits and vegetables (potato and banana for example), which could not be adequately preserved through use of this facility. Perishable foodstuffs may be converted into stabilized products when stored for extended periods of time, by employing technologies such as canning, freezing, freeze-drying, dehydration, fermentation, irradiation, etc. The linkage with the processing industry will also provide an outlet for utilization of waste or appropriate waste disposal, when necessary.

17. Fruits and vegetables are particularly sensible to mechanical injury and microbial decay and genetical engineering is developing plant research to

preserve quality for a longer time and to cut losses during harvesting, processing, shipping and marketing.

18. In the meantime waste utilization, therefore additional food potential for feeding people or cattle or for export, can be integrated in the processing plant so as to make maximum use of fruits and vegetables as major sources of vitamins and minerals. Recycling of waste and mechanical recovery are quite efficient processes. By-products of fruits and vegetables such as pulpwash, citrus cells, peel oil, essence, are expanding their industrial processing and marketing within the same optic of loss reduction in terms of nutritional factors produced and not used.

IV. Efficiency, Productivity

19. The concept of productivity is certainly easier to conceive than to achieve since pursuing productivity is not a short-term goal. The reward, however, fully justifies the effort.

20. Technological innovation plays an important role in a deeply changing sector like the food processing sector for achieving more production, better quality and for providing the necessary flexibility to adjust to innovations also occurring in the packaging sector. Processing methods are complex, particularly since raw materials vary so much and develop very rapidly.

21. Once canned foods contained additives and preservatives. Today the heat sterilization of the canning process preserves food without additives or preservatives and the can protects its contents from contamination. Fruits and vegetables are picked up at the peak of ripeness and sealed into cans in about three hours. In recent years the frozen food industry has also developed greatly and it is said to challenge canning for many types of food.

22. Technologies for mobile units are also available taking into account the conditions in developing countries. The mobile units are carrying out heat treatment processing and packaging, requiring water, energy and waste disposal. Mobile technologies are applicable on small-scale basis reducing transport distances. They are adaptable to local conditions and resources.

23. Irradiation is not a new technology since it was first patented as a food preservation process in 1930. It certainly offers numerous benefits in inhibiting sprouting of vegetables, delaying ripening of fruits and vegetables, destroying insects and preserving a variety of foods for extended shelf life. Its commercial application is however limited, due to a number of factors such as governmental regulations, safety concerns, and consumer acceptance.

24. Freeze-drying is a food preservation process whose technology has been known for many years. Its application is now growing in the food industry but cost factors related to investment and to plant operation, including utilities costs, make this preservation process mainly suitable for high-value products.

25. Product quality has always been a key issue in the food industry. Yet, the philosopy behind product quality has changed in recent years. Traditionally, emphasis was placed on the final product, making inspection of finished goods very costly and not improving product quality. Quality

assurance and quality control today should rather be seen as day-to-day quality programmes at the plant level, built-in part of the whole technical process with the involvement and commitment of all concerned.

26. Besides, with the changing of processing and packaging methods, testing and quality control have to adjust rapidly to new products put into the market.

27. Food processors and packaging suppliers have to work closely together bearing in mind the consumer needs and expectations to solve a number of problems related to cost, transport, safety and waste of packaging materials in one word, performance requirements of packaging.

28. Modern packaging is characterized mainly by paper-based and plastic packaging materials, their combinations (laminates) and metal-based materials; however, successful efforts have been made to improve traditional glass packaging, for example by reducing wall thicknesses or by using plastic coating on bottles. Modern wooden packaging is mostly used for transporting smaller packages. There is a wide range of wooden packaging methods in many developing countries.

29. At the international level, the choice of the applied packaging materials, methods and technologies depends on the processed fruits and vegetables, the characteristics of the end-products and the effects of the preservation technologies.

30. In the developing countries, hygienic requirements of the market and the often adverse climatic, transport and storage conditions should be taken into account. Thus, the most appropriate packaging would be metal-based (steel-plate, aluminium, chromium-plated steel plate) products, various combined plastic-metal-paper laminates and glass packaging materials. For juices, plastic bottles have now come into general use (depending on the properties of the fruit and the carbon dioxide content of the juice) and various polyolephines (PE, PVC, PP, polyester-based) packaging materials can be used. It is expected that, owing to more intensive use of the aseptic technology, combined packaging materials are likely to come to the front.

31. A decisive factor in the production of materials currently in use and those under development is economic efficiency. In the case of tin-plate, this could be achieved by a further reduction in plate and tin thicknesses and more efficient lacquering methods, in the case of glass materials by volume reduction and in the case of combined materials by more intensive use of sterilized materials. Complex cost calculations must be carried out before a final decision is taken. In certain developed countries an economical comparison was made in 1983/84 of aseptic technologies using different packaging materials and methods. Liquid food products, including fruit juices, were examined. The evaluations covered the total costs of the distribution system, including production and consumption costs, under well-defined conditions (price, availability etc.). (The results of the evaluation could also pertain to other food products). The conclusions reached are shown in the following table.

Comparison of costs of glass, metal and laminated-paper packaging as a percentage of total costs

| Cost item | Glass | Metal | Laminated Paper |
|---|---|---|---|
| Packaging | | | |
| Consumer | 58-60 | 73 | |
| Collective and transport | 16 | 10 | |
| Subtotal | 74-76 | 83 | 70 |
| Processing and filling | 2.5-3.5 | 1.6 | 7.2 |
| Storage of empties | 0.8-1.3 | 0.3 | 1.1 |
| Transport and storage | 13.6-15.1 | 10.9 | 10.7 |
| Handling | 4.9-5.8 | 4.1 | 9.12 |

32. For processed fruits and vegetables, the trend is towards high-grade mechanization guaranteeing hygienic safety and longer shelf-life. On the other hand, packaging methods that preserve the original aroma and vitamin and ingredient content of products are being widely developed: for example, the application of additives to preserve freshness, together with a sterile technology in a vacuum or controlled microclimate provide a means of preservation without cooling.

33. Concern is being expressed in several countries over the biodegradability of packaging which constitute, in a country like USA, 150 million tons of garbage per year.

34. Manufacturers need to make products which result in waste of low quantity and toxicity. So far many creative market-oriented innovations have been presented by the packaging industry but only few in the area of environmental acceptable packaging. The efforts in this direction have been so far directed towards eliminating or reducing environmental ill rather than towards anticipating the recycling/disposal problems. In this area, government support to investments in recycling and waste plants through financial and tax incentives has an important role to play.

V. Manpower training at all levels, management and organization skills

35. Food processing is traditionally more art than technology in the rural areas of developing countries. But in order to make the best possible use of food resources, in terms of preventing losses and retaining nutritive value, the technology portion must increase.

36. Although at present the spread of new technologies and training still differs from country to country it is nevertheless likely that the challenge of technological change will cause the trends to converge. Not very many new occupations have been so far created by the utilization of the technologies, which are known today. Rather the contents of jobs are changing considerably

and there will be a change in the importance of individual tasks within job categories. The utilization of new technologies requires not only new technology-oriented knowledge. In view of the all-round structural changes that are affecting the economy and society, in which whole industries, regions and manpower risk being marginalized in the development process, a training policy is needed which incorporates further training of manpower.

37. Although training content has to be adapted to each country's agricultural, industrial socio-economic, food situation and although each training institute has to choose for itself what seems to be the most appropriate training methods, it remains true that some aspects of food industry training will be broadly similar in different countries.

38. Human resource development and training should however be concentrated on management operations, and on the personnel dealing with technological processes and development programmes. In this area it is recommended that operational manuals related to training and technological processes should be worked out and utilized at all levels covering specific elements of production.

39. The problems will also be approached by giving trainees access to existing national documents (statistics, industrial and agricultural surveys, final reports of industrial development projects and products marketing projects, pricing policy documents) the analysis of which will provide them with information to help them gain a better understanding of the country's agro-industry problems.

40. In many developing countries food technology is experiencing a vigorous development and governmental resources, among other, are making successful efforts to impart new skills through training in the various aspects of fruit and vegetables production, processing and distribution systems. Public sector training programmes conducted by research institutes and governmental agencies should be aimed at reaching the various levels of trade and industry: large, medium, small scale and cottage level and should provide training in various skills encompassed in these levels: traditional techniques, technical skills and academic or management know-how.

41. The combination of research and training services linked together offers the benefit that new knowledge is transferred to industry and other academic centres. The philosopy of combining research with training works well in responding to manpower and information needs of the food industry. Research and development institutes receive the support of industries in various ways. The mutually reinforcing nature of research and development relationship with industry, in both the public and private sector of food industry, is a means that, when achieved, can serve as an example in planning the development of training centres for teaching applied technology.

42. Research and development institutes can organize short-term refresher courses for industry personnel in order to make available new knowledge and research results for industrial use. They also provide consultancy services to solve problems which require theoretical expertise. This role is particularly valuable when fruits and vegetable processing industry do not conduct extensive research and development activity.

43. One example could be the selection of equipment whereby the R and D institute is able to design or adapt machinery for specific uses which then obviate the need to import foreign technology. Both the consultancies and the short-term courses serve a trouble-shooting function of R and D for the public and private sectors of industry.

44. Industry can provide support for tuition costs for a proportion of trainees and also the opportunity of practical field experience after the coursework. Industry representatives may give lectures occasionally to enhance the regular training programme. Ultimately, all parties benefit, through the employment of graduates whose training has covered the technical subject more broadly and deeply than required.

VI. Markets

45. The number of people living in cities increased more than threefold from 600 million in 1950 to over 2.2 billion in 1988. By the year 2000 more than half of humanity will be city dwellers. The rapid urbanization of the world is among the major causes for steadily increasing marketing margins, i.e., the costs of getting food from producers to consumers. The farther consumers live from food production areas, the more important marketing becomes. This is because, and this applies both to domestic and export markets, the distance between food producers and consumers increases geographically, in form and in time.

46. In 1988 at least 800 million people were on diets that fell short of essential nutrients such as vitamins and minerals. Evidently the technology of marketing, which includes all functions performed in getting food from producers to consumers, has been neglected or given low priority. Prime concern is often the increase of production, agricultural and industrial. The price paid, however, for this neglect of marketing is very high: increasing food imports, large post-harvest losses, growing malnutrition. In spite of the increased agricultural and industrial food production occurred in the last 35 years or so, it turned out that even if there is enough food in the world it does not reach all those who need it.

47. The international market plays an important role in respect to the development of tropical fruit and vegetables production. The influence of imports should be limited to quantities but also take into consideration quality, prices and potentiality for further growth. The introduction of these products in sophisticated markets like the European countries and, to some extent, the United States and Japan was a long way and required a great deal of effort directed to the production of products in accordance with the market requirements in respect to acceptance of new flavours, in finding the proper way to promote the new products and make them pricely attractive.

48. There is evidence that the upwards trend of tropical fruits will continue, particularly now when there are signs of a new phase of economic growth in Europe after a period of recession. The main factors explaining the acceptance of exotic fruits both fresh and processed in the international market are:

- increased travelling and exposure to exotic flavours;
- increasing wealth and spending power;
- promotion;
- lower prices

49. The above factors influence both the fresh and processed items.

50. In respect to the processed products, the main factors influencing the increase in demand are:

- the use of new packaging, aseptic cartons (tetrapack);
- introduction of multi-fruit drinks

51. Processed tropical fruit and vegetables are becoming current components of the diet of a large number of industrialized countries. In addition to importing, several of these countries also produce or re-export products which are re-processed into their final consumption forms.

52. The market of pulps and paste which are processed into final products and re-exported makes it difficult to obtain statistical data of consumption in different countries which do not have a statistical breakdown of all the processed fruit and vegetable products. It can be stated that in one way or the other the tropical products under study have internationally been incorporated into the eating habits.

53. The problem of marketing has a different aspect in developed countries where the food marketing is aimed at meeting consumer demands quickly and directly. Criteria such as flavour, health, variety, convenience, portion control and value are behind products success or failure.

54. Nutrition-related issues that are of most concern include vitamins, minerals and sugar. Considerations related to demographical and sociological factors such as changes in age of consumers, increase of women in the workforce, have a strong impact on food demand as well as new types of retail stores like hypermarkets and take-out shops.

55. New trends due to the advent of microwave or to preferences for health food by an increasing number of health-conscious consumers are altering traditional food marketing techniques. There is therefore a constant need to monitor consumer taste using all that technology can offer.

56. More and more market research, new product development, packaging and information technology will be required in view of the changes in the fruit and vegetable processing industry.

57. As far as the Single European Market of 1993 is concerned, an EEC research programme, FAST* II, studied changes in the food area because it was felt that new technologies, particularly biotechnologies, could revolutionize the food system in the coming years. Besides, the food system in Europe involves 320 million consumers and employs 20 per cent of the EEC workforce

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*Forecasting and Assessment in Science and Technology.

(farmers, food processors, catering and distribution employees), playing therefore a vital role in European life. Emphasis according to FAST II will be more and more on quality, diversity and healthy products. Labelling will focus attention on components of food and there will be a decline in the use of synthetic colours and flavours. The use of natural materials is forecast to rise. An extensive research programme, the Food Linked Agro-Industrial Research (FLAIR) will promote research into the assessment and enhancement of food quality, food hygiene, safety and toxicology.

58. The ability by developing countries of exploiting newly emerging market niches for fruit and vegetable products has therefore to be fostered as well as promotion and market intelligence.

## VII. Final Considerations

59. In the light of the above appreciation of the status and problems of the fruit and vegetable processing in the developing countries in the context of domestic and international supply/demand perspectives, the Consultation Meeting may wish to examine the following key considerations with a view to reaching conclusions and recommendations for enhancing the development of the sub-sector, namely,

(a) The economic and social importance of the sub-sector

(i) Contribution to food supply and security objectives: malnutrition - balanced diet

(ii) Employment creation in the rural areas: rural-urban balance

(iii) Efficient utilization of raw material resources: reduction of waste through processing, waste utilization, by-products

(iv) Contributions to foreign exchange earning/savings - objectives

(v) Linkage and spread effect benefits as part of agro-industrial systems and integrated rural development

(vi) Growth opportunities for small and medium enterprises in the sub-sector as well as in related manufacturing inputs production and service activities which its expansion would generate

(b) Supply/demand prospects of the sub-sector

(i) Production for domestic demand: promotional measures, nutritional problems, dietary habits

(ii) Production for exports (interregional and international markets)

(iii) Global institutional, legal and trading arrangements affecting the future export potentials of the developing countries

(c) Policy and institutional pre-requisites for the development of the sub-sector

(i) Strategic planning and policy formulation to integrate the fruit and vegetable processing sub-sector in the agro-industrial system, rural development programmes, agriculture and industrial policies and programmes:

-new productive capacities
-industrial rehabilitation and restructuring

(ii) Public sector policy and incentive measure to create the environment for increased private (domestic and foreign) sector investments:

-Reorientation of industrial policies focussing on integrated agro-industrial development in which the fruit and vegetable sub-sector would play its assigned role in economic and social development and which at the same time would serve as a framework for inducing investments;

-Development of institutional capabilities for export and investment promotion, research and development, standardization and quality control, training;

-Establishment, administration and harmonization of an effective incentive system.

(iii) Policies and programmes for the mobilization of financial resources:

-Capabilities for the identification and preparation of investment projects and for consultancy engineering services;

-Entrepreneurship development;

-Domestic and international sources of financing: priorities and requirements.

(d) Prerequisites for operational efficiency and productivity

(i) Technology options and choices

-Spectrum of technologies: drying, canning, quick-freezing, freeze-drying, aseptic techniques

-Alternative technologies and choices

-The role of R+D institutions

-Production process and quality control

(ii) Packaging

-materials and costs
-design of packaging alternatives
-consumer preferences
-domestic and export market requirements
-packaging machinery

(iii) Skills development

-technological, plant level, managerial and organizational
-institutional programmes for development of skills

(iv) Administration and organization efficiency

-coordination of public programmes: national, zonal and community
-delivery of information and promotional services to investors
-inter-sectoral and inter-industry linkages

(v) Raw-materials supply

-contractual arrangements between agricultural producers and purchasers;

-quality up-grading through better utilization of agricultural chemicals, mechanization and biotechnology innovations;

-expansion of rural transport equipment industries

-provision of storage facilities as well as repair and maintenance workshops.

(vi) Quality control and standardization

(e) Market and Marketing

(i) market development: national, regional and international

(ii) market information and intelligence systems:

-tropical products
-others
-market promotion skills

(iii) packaging pre-requisites

-quality control, standardization, possibility of recycling, consumer preferences

(iv) tariff and non-tariff barriers

(v) distribution channels